new and very powerful agents, by which it became possible to isolate from their compounds several elements the existence of which was well recognised, but which had previously resisted all attempts to obtain them in a separate state. Among these was aluminium, which was seen for the first time in 1828 by Wöhler, who succeeded in decomposing the chloride by potassium. With the substitution of the cheaper sodium for potassium, and the occasional replacement of the chloride by the fluoride of aluminium, this was practically the method adopted by the experimentalist and manufacturer alike down to quite recent years. The Aluminium Company, already referred to, was formed for the purpose of working such a process with the use of sodium obtained more abundantly and cheaply than before by Castner's process. All this is now changed. So long ago as 1854 aluminium was deposited in the metallic state by the electrolysis of the fused chloride of aluminium and sodium according to the method introduced by Bunsen. It was also stated to have been obtained by the electrolysis of aqueous solutions of certain aluminium compounds, but this appears to have been a mistake. The method now adopted consists in subjecting to the electric current pure alumina in a fluid state, that is fused alone or dissolved in melted cryolite.

Now that the energy of falling water is being turned to account on a large scale, works have been established at Neuhausen near the falls of the Rhine, at Niagara, and at Foyers in Scotland, for the production of the current by means of vast dynamo machines, and its application, among other chemical manufactures, to the reduction of aluminium.

Little else remains to be said of the book except by way of commendation. A few minor matters have been passed over rather slightly. Thus the solubility of calcium sulphate in water containing chlorides is a matter of some importance from a technical point of view; and the simple statement of the text (p. 437), that "according to Anton 1 part of gypsum dissolves in 122 parts of a saturated solution of sodium chloride," is neither very precise, nor is it of much practical use. A long series of determinations of the solubility of calcium sulphate in chlorides is provided by the work of Lunge (*J. Soc. Chem. Ind.*, 4, 31), and by that of Tilden and Shenstone (*Proc. R. S.*, 38, 331). As regards the temperatures supposed to be indicated by the colours developed upon the surface of steel in the process of tempering, it has been shown, more especially by Turner, that these colours can be *successively* developed by protracted heating to the same temperature, and under any circumstances are not to be interpreted to within a considerable range of degrees. As the interesting lead tetrachloride has been properly mentioned, the more stable tetracetate (Hutchinson and Pollard) should have been noticed at the same place.

The whole of such a volume as this should be read attentively by every serious student of chemistry; and if this treatise does not displace all other English text-books devoted to mere description, it will be solely on account of the unfortunate but unavoidable high price, a consideration which necessarily influences so many students in their choice. W. A. T.

SUBMARINE CABLE TESTING.

Student's Guide to Submarine Cable-Testing. By H. K. C. Fisher and J. C. H. Darby. Pp. 165. (London: *The Electrician* Printing and Publishing Co., 1897.)

THIS practical and useful little book is designed as its title indicates, and, as its authors state in their preface, to meet the requirements of young students in this particular branch of submarine cable engineering, and to endeavour to place before them in as concise and lucid a manner as possible, not only the practical problems involved in the study of cable-testing, but also the simple algebraical formulæ necessary for their solution.

Many of the large submarine cable companies now demand that their employés shall qualify themselves in electrical subjects, and shall pass certain examinations before being considered eligible for promotion from the lower to the higher grades of the service.

This very proper requirement on the part of the companies has resulted in stimulating their staffs to greater exertions; but it has been found that the ordinary text-books in circulation are either too theoretical and advanced for beginners, or fail to deal with and thoroughly explain just those particular points upon which they seek instruction.

The authors of the little work under review—practical electricians and cable engineers themselves—were constantly being asked for information upon these points, and their first effort to meet this demand upon their time and patience took the form of a small pamphlet entitled "Notes on Practical Cable-Testing," of which a small number was printed and issued privately.

This first effort was so far appreciated, as to encourage them to hope that a more ambitious work, carried out on the same lines, might be found still more useful; and although, as the authors modestly remark in their preface, "the scope of the present work is bounded by the requirements of the electrical examinations for supervisors, and the ordinary electrical outfit of all the company's stations," we venture to think they have so far succeeded in their purpose, that this book will be found of practical value, not only to those for whom it was originally written, but to all desirous of studying and understanding this most interesting subject.

As we have already observed, too many of the existing text-books are the works of theorists who do not concern themselves with the practical features of the matters upon which they write; in fact, who do not possess the necessary practical experience themselves, which would enable them to do so satisfactorily; and we think, therefore, that this little book will be accepted, and rightly so, as a useful contribution not only to our knowledge, but also to submarine cable bibliography.

The work is divided into two parts: the first dealing with simple testing, such as the measurements of resistances and of electrostatic capacity, together with the testing of batteries for electromotive force and interna resistance; and the second, with the various known methods which are adopted for the localisation of faults in submarine cables.

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In a book of this description it would be invidious to criticise too closely, or we might be tempted to question some of the definitions of terms in the opening chapter, such as "Farad—the practical unit of capacity" and "Shunt—a conductor, usually a resistance box, for leading into another channel part of a current that is too powerful for the immediate purpose."

The idea, however, seems to have been to convey to the reader the practical sense of things, and not to split hairs as to choice of terms. The chapter on that electrical *pons asinorum*, the theory of the Wheatstone Bridge, is especially clear and well put, and the student who reads and digests it thoroughly may cease to frown at the name of Kirchhoff, the sum of whose quantities has frequently an aggravating habit to the student mind, of equalling nothing.

Paragraphs 54–55, pp. 55–59, explaining the necessity for ascertaining the proper time constants to be allowed in charging long cables, whose resistances it is required to measure, are very important to learners, and should be carefully studied. Three simple rules are given for determining these constants in the cases of (1) a perfect cable, (2) a broken cable, and (3) a faulty cable, and it is suggested that an ordinary metronome, such as is used in beating time for music, will be found of great assistance in measuring the time for charging and discharging.

Articles have recently appeared in the technical journals, and some discussion has followed, upon the relative merits of the "scale zero" as opposed to the "false zero" method, for fault localisation especially. Upon this head the authors remark: "We will now describe the 'false zero' method. We consider this method by far the best and most accurate . . . especially with a faulty cable"; and again at p. 54, with special reference to Mance's method for eliminating the resistance effect of an earth current, they observe: "It may be pointed out here that the statement that R, the resistance equivalent to the E.C. varies inversely as *c*, the current to line, is not quite correct in the case of faulty cables. If the testing current be reduced or increased, it slightly *reduces* or *increases* the E.M.F. due to *polarisation of the fault*, and therefore the current set up thereby, but we have not found this error to be as a rule appreciable."

The tests for the measurement of capacity are clearly explained as far as they go, and numerous references are given to various text-books and other publications, to enable the student to follow out for himself the study of the effect of the phenomenon of absorption upon different dielectrics.

In the second part of the book, a description of the various tests employed for localising partial faults, and total breaks in submarine cables, is prefaced by a few interesting preliminary remarks upon the nature of these faults, and their behaviour under the influence of the testing current.

It is interesting also, and instructive, to note the headings under which they are grouped, such as those due to submarine borers, to chemical action, *fish-bites*, punctures, &c.

We must, however, take exception to the expression "Kennelly's law" in the description of his tests for total breaks. A "law" in this sense must be absolute and unchangeable, whereas Kennelly's "*rule*" that, "when the exposed area of a break is constant, its resistance varies inversely as the square root of the current strengths passing through it" is only true between certain limits of current. Kennelly pointed this out himself, and Schaefer has since demonstrated that beyond 25, and up to 50 milli-amperes, the resistance varies inversely as the 1·3th root of the current strengths.

The authors have endeavoured to make the various sections of their book complete in themselves, and have added a number of diagrams of connections for signalling on cables, which form a new feature in works of this description, and which, with the various tables of temperature coefficients, will no doubt be found useful.

We may add that nearly all the examples are actual tests of cables, and are given very fully in the hope that they may tend to throw a practical light upon the explanations of the various tests.

In conclusion, we feel it incumbent upon us to recommend every student of submarine cable engineering to add this little volume to his library.

BRITISH MOTHS, AND THE GENUS DIANTHŒCIA.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera and Species indigenous to Great Britain and Ireland, their Preparatory States, Habits and Localities. By Charles G. Barrett, F.E.S. Vol. iv. Heterocera. Noctuæ. 8vo, pp. 402. (London: Reeve, 1897.)

THE fourth volume of Mr. Barrett's elaborate work includes ninety-eight species (three of which, however, are regarded by the author as doubtfully British) distributed among thirty genera of the *Noctuæ Trifidæ*, to which group belong by far the larger part of the European stout-bodied, night-flying moths. This gives us an average of something like four pages to each species, though many of the notices run to six or seven pages; and on such a scale it will require twenty volumes to complete the life-histories of our British Lepidoptera.

Mr. Barrett is well known as one of the best of our practical entomologists, and the history of every species is worked out with extreme care, the observations of numerous lepidopterists throughout the British Isles being freely utilised, in addition to those of the author himself. The foreign range of each species is also briefly indicated, though the character and extent of the book prevents almost any allusion to allied species not occurring in Britain, except so far as such notices are absolutely necessary to elucidate British species.

Considerable space is devoted to the genus *Dianthœcia*, which includes eight or nine British species, most of which are coast-frequenting insects with us, the moths being found flying over *Silene* in the evening, often on precipitous sea-cliffs, where it is not unfrequently a task of some difficulty and danger to capture them. The larvæ are described by Mr. Barrett as "smooth, plump, with the head small, usually feeding on or in the blossoms or seed-vessels of plants belonging to the *Caryophyllaceæ*."

Britain is called by the French entomologists, *le pays de variétés;* and the British species of *Dianthœcia* are

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